Asia Science Letter

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The Asia Science Letter is a bi-monthly publication of the Asian Office of Aerospace Research and Development (AOARD), Detachment 2 of the US Air Force Office of Scientific Research (AFOSR), the basic research manager of the Air Force Research Laboratory (AFRL). Its purpose is to inform the Air Force S&T community on the research and development activities in Asia and Pacific Rim countries including India and Australia. The assessments in this periodical are solely those of the authors and do not necessarily reflect official US Government, US Air Force, or AFOSR positions.

Highlights

The week of 10 January was an exciting week for the AOARD Team with many important visitors. Col. Steven Reznick, Commander of the HQ AFOSR, Ms. Vicki Cox, Director of AFRL International Office and Maj. Robin Sneed, Reservist at AFOSR, visited to discuss all aspects of operational support and strategy for AOARD. Dr. Bill Berry, Director of AFRL/DC (SAF/AQR), also visited the office while attending the US-Japan Systems and Technology Forum taking place that week. In addition, the collocated Tri-service offices received an unannounced visit by Dr. Jacque Gansler, Under Secretary of Defense for Acquisition and Technology, who was in Tokyo to chair the Forum. This unexpected occasion gave the AOARD Team and the HQ visitors an opportunity to present a comprehensive picture of AFOSR and AOARD missions and roles in the Air Force.

AFOSR has initiated an "Asian Initiative." FY 00 funds have been set aside to promote awareness in Air Force technical community of the technology-leverage opportunities in Asia. The initiative consists of the following two parts:

1. Travel funds are available for Air Force scientists and engineers to attend conferences and/or conduct technical assessments in Asia. Please send us an email if you or your US Air Force colleagues are interested in this new assistance.
2. R&D funds are available to fund cutting-edge high pay-off research relevant to the US Air Force. We accept proposals throughout the year from research organizations in Asia proposing to work closely with the Air Force research community. The proposals will be evaluated through a scientific review process, and selected for award on a competitive basis. Please contact us for more detailed application procedures.

Koto White
Director, AOARD

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Feature Article

Multi-sensory Command and Control in Asia:

Mr. Lawrence Finegold, Deputy Program Manager for Multi-Sensory Command and Control Advanced Technologies (MCCAT) for Information Operations (IO) Applications, visited Japan in November to assess possible technology development partnering and technology insertion opportunities for the new AFRL/HECA Multi-Sensory Command and Control Advanced Technology (MCCAT) 6.3 program.

He visited Japanese Universities (Tokyo Institute of Technology, Nara Institute of Science and Technology, and Nihon University), Government-Industry Consortia (Mixed Reality Systems Laboratory and the Advanced Telecommunications Research Laboratory), Government Institutes (Nara Research Center), Commercial ventures (VR Center and Digital Hollywood) and AOARD. Specific areas of interest included information display technology and user-system interface R&D.

This visit followed up the visit to Japan by Dr. Kenneth Boff, Chief Scientist of AFRL/HE, in November 1998. Mr. Finegold will use his results in the process of selecting the specific technologies that might be used in the FY02 MCCAT Concept Demonstration and FY03-05 Prototype Demonstrations.

The following sites were visited by Mr. Finegold.

- **Tokyo Institute of Technology, Human Interface Section, Advanced Information Processing Division, (Prof. Makoto Sato and Dr. Masahiro Ishii):** Networked virtual environments with visual, auditory, and haptic interactions are featured. Haptic control devices were demonstrated including haptic feedback to two participants in a simultaneous activity or for activity with two hands and force feedback applied to large virtual spaces (i.e. shooting a basketball). Potential applications include both training and robotic tele-presence.

- **Digital Hollywood, Tokyo:** Dr. Tomoyuki Sugiyama is a leading expert in computer generated image (CGI) techniques and has served as a consultant on several major Hollywood films. Digital Hollywood is a network of schools teaching computer visualization techniques, multimedia, animation, visual effects, and web production. These technologies would have potential applications for information operations, space applications, and advanced training techniques.

- **Nihon University, Department of Psychology, Tokyo, (Prof. Hiroshi Yamada):** Research is being conducted on facial recognition and recognizing the emotional content of facial expressions including creation of models using extraction of feature points.

- **Mixed Reality Systems Laboratory, Inc. (MR Lab), Yokohama, (Dr. Hidey Tamura, Dr. Susumu Matsumura, Dr. Hiroyuki Yamamoto, and Dr. Toshikazu Ohshima):** Established in 1997, the MR Lab is a joint venture between the MITI Key-Technology Center and Canon in collaboration with the University of Tokyo, University of Tsukuba, and Hokkaido University. MR lab conducts R&D in mixed reality displays attempting to overlay computer generated imagery on physical reality (Mixed Reality) addressing observer motion. The lab demonstrated collaborative augmented reality systems including an air hockey game that spatially and temporally coordinates virtual and real space and an interactive visual simulation the "MR Living Room" that minimizes the photometric gap between the real and virtual worlds. The "Cybercity Walker" Project applies MR technology to large virtual spaces based on real photographic images. One MR Lab goal is the development of compact, light-weight head mounted displays with high luminance and a wide field of view. They have made significant advances in see-through head mounted devices - a newly developed Canon see-through system has 920,000 pixel resolution and a 51 degrees field of view. The lab is also working on 3-D visualization on a PC without special glasses. The newly developed "Rear-Cross-Lenticular 3D Display" was impressive with a wide observation field. The physiologic reactions caused in both the visual and autonomic systems by head mounted displays is also being researched. In general, MR Lab research looks very promising, especially for training systems and portable man-machine-interface development.

- **Virtual Reality Center (VRC), Yokohama (Dr. Hiromi Kobayashi and Dr. Christian Carme):** With 50 million yen of capital from its parent company 3D Inc., VRC conducts virtual reality related education, consulting, system (hardware) integration, and sales of related products.

- **Advanced Telecommunications Research (ATR) Institute International; Kyoto, (Dr. Sakai Yasuyoshi, Dr. Shigeru Akamatsu, Dr. Jean-Christophe Terrillon, Dr. Erik McDermott, and Dr. Alain Biem):** Visual identification of operators, voice recognition, speech recognition, language translation,

and speech synthesis were demonstrated. Basic research findings are being applied to the design of specific prototypes. A prototype application designed to make travel and hotel reservations was also shown.

- **Nara Institute of Science and Technology (NAIST), Image Processing Laboratory, Nara, Japan (Dr. Kunihiro Chihara, Dr. Kazumasa Yamazawa, and Dr. Tomohiro Kuroda):** The NAIST Image Laboratory, conducts research in the areas of virtual reality (VR), Augmented Reality (AR), and new user-system interface technologies. Facilities include a panorama cave, various head mounted displays (HMDs), Onyx-2 and other SGI machines. NAIST demonstrated
  - a portable AR system with HMD,
  - a wearable computer,
  - applications of AR in the inspection of electronic boards
  - VR crossing of a rope bridge base on real world imagery (very impressive)

  The impact of mixed reality (MR) on processing time and error rate for real world tasks and the application of real world panoramic images and capturing 3D range data for the creation of VR are also being studied. NAIST research is particularly relevant to training and wearable displays.

- **Nara Institute of Science and Technology (NAIST), Graduate School of Information Science, Information Technology Center, Nara, (Dr. Suguru Yamaguchi and Dr. Ken-ichi Chinen):** Web access optimization, use of proxies and caches, and data visualization were presented by some of Japan's leading experts on Internet issues and computer system security at the Information Technology Center. Potential applications include computer network defense approaches.

- **Nara Research Center, Nara, (Dr. Naokazu Yokoya and Dr. Kunihiro Chihara):** Funded by the Ministry of Post and Telecommunications, Telecommunications Advancement Organization (TAO) and collocated with the Nara Institute of Science and Technology, this center conducts research on generating 3D mixed reality environments using real and computer generated images and synchronizing image, sound, and motion. A VR roller-coaster incorporating sound, chair motion and real world imagery was demonstrated. Potential applications include aircraft simulators. (Lyons)

Aerospace

Site Visit: Aging Aircraft Test Facility at the Defense Science and Technology Organization (DSTO), Fisherman's Bend, Melbourne, Australia; 7 Dec. 1999: The DSTO, part of the Australian Department of Defense, conducts R&D and makes decisions on the purchase of new defense equipment. Currently DSTO's scientific investigations support existing aircraft capabilities by enhancing operational performance though life extension. The International Follow-On Structural Test Project (IFOSTP) facility can accommodate a full-scale test of the F/A-18 Hornet aircraft. This research will assist verifying the fatigue life of the F/A-18 and support radar performance, infrared self-protection techniques, and radar cross section control upgrade projects. Using a unique design, the IFOSTP simulates the stresses and loads of an F/A-18 in real flight conditions. The USAF and DSTO currently have a project to reduce the damaging effects of buffeting (flutter) on the vertical stabilizers and wings during high angle-of-attack flight maneuvers. This project proposed a vibration suppression system using a "smart structure"-like control by using piezoelectric actuators to reduce the structural response to adverse aerodynamic loads. The IFOSTP results are expected to save the Australian government about $650 million by extending the F/A-18's life.

The only country flying the F-111 aircraft, Australia plans to keep the F-111 operational until 2020. Likewise, DSTO has begun to evaluate full scale fatigue testing and to validate computer modeling techniques to predict the behavior of fatigue cracks and corrosion in this aircraft. Non-destructive inspection (NDI) techniques are being developed to extend the operational life of this aging aircraft. (Kim)

Site Visit: Cooperative Research Centre for Advanced Composite Structures Ltd. (CRC-ACS), Fisherman's Bend, Melbourne, Australia; 7 December 99: Established in 1991, CRC-ACS is a research center promoting composite manufacturing industry in Australia. Research activities range from investigations into raw materials and their processing methods to the development of design standards and codes of practice. The primary research effort is directed toward the test and evaluation of advanced composite materials and their fabrication processes. Working with CRC-ACS's technical staff of 80, cooperative research programs exist with universities throughout Australia (Monash University, Univ. of Sydney, and Univ. of Newcastle) and industrial research organizations. The five major research activities are:

- Materials Science: Develop, verify behavior and obtain properties of advanced composite materials to support the manufacturing industries.
- Improved Manufacturing: Develop existing and alternative processes for the cost-effective fabrication of composite parts.
- Improved Structural Performance: Develop and extend the capability to design, optimize and certify high-performance composite structures.
- Improved Operations: Develop techniques for assessing and improving the operational aspects of composite structures including repair, safety, and recycling.
- Technology Demonstration: Transfer of technology to reduce the risk to industry by producing demonstrator parts.

CRC-ACS is currently collaborating with many countries to develop composite structures. For example, CRC-ACS has teamed-up with Airbus to develop a low-cost wing for a passenger aircraft. CRC-ACS was responsible for the design, manufacture and test of the stringers. An innovative fabrication method using non-crimp materials and resin transfer molding in heated tools was extensively used. (Kim)

Conference: International Workshop on Fracture Mechanics and Advanced Engineering Materials, University of Sydney, Australia; 8-10 December 1999.
In recent years significant progress has been made in many areas of fracture mechanics and advanced materials. About 80 participants discussed all aspects of fracture and fatigue mechanics. Areas covered included damage mechanics, integrity and reliability, thin films, functionally graded materials, smart materials, and polymers and composites.

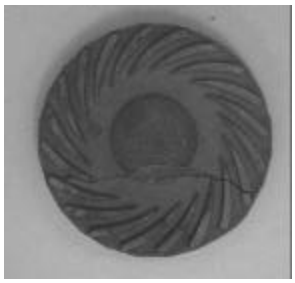
Dr. Jun Takahashi presented a novel loop fiber optic sensor for monitoring bearing failure of the bolted joint of composites. By detecting the bend loss of an optical power transmission, this method has a practical advantage over the other methods since damage in structure is monitored by detecting a break in optical fiber. The durability of the sensor increases and the embedding process is simpler because the optical fiber coating is not removed during installation.

Prof. Xia Chen of DSTO presented research on the fracture of transparent conducting oxide films deposited on thin flexible substrates that applies to thin layered electronic devices such as organic light emitting displays (OLED). The OLED has a promising future in panel display industry because it can be made flexible and lightweight with a wide display angle and high resolution. Mechanical testing results showed that fracture of a thin film such as indium-tin-oxide (ITO) is superficially similar in both tension and compression. However, under tension, a channeling crack is formed and under compression, the film delaminates, buckles and cracks in tunneling motion. These results on fracture and interfacial toughness may lead to robust and flexible electronic devices. (Kim)

Micro and Nano Systems

Site Visit: Micro-turbine Research at Tohoku University, New Industry Creation Hatchery, Tohoku University, Japan; 11 February 2000:
Researchers at Tohoku University are developing Silicon Carbide (SiC) microstructures for the fabrication of micro-power technology components such as micro-turbines (Figure 1).

(Turbine side)



(Compressor side)

Figure 1. SiC micro-turbine

SiC microstructures are well suited for microsystems experiencing environmental extremes or harsh environments since SiC is a hard, wear resistant material with the ability to withstand high temperatures and corrosive chemicals The cost effective SiC fabrication technique developed by Dr. Masayoshi Esashi (http://mems.mech.tohoku.ac.jp/esashilab), Dr. Shuji Tanaka, and Mr. Shinya Sugimoto facilitates the production of unique SiC component shapes with excellent mechanical properties.

The new SiC fabrication process uses a Si mold formed by deep-RIE. This mold is filled with α-silicon carbide,

graphite, Si, phenol resin and isopropanol and prepared for sintering. After sintering the SiC is released from the mold by wet etching. Several molds can be stacked to create complex shapes over 1 mm tall and 10 mm wide. The SiC component feature resolution is limited by the mold accuracy and sintering material grain size (approximately 5 μm). This method has advantages over the other SiC forming methods such as electric discharge machining (EDM), chemical vapor deposition (CVD) and reactive ion etching (RIE). SiC EDM components have limited feature resolution. CVD and RIE require excessive fabrication time reducing commercial viability.

Currently the Tohoku University SiC fabrication technique is being applied to the development of a micro-turbine. Although there is a loss of turbine efficiency with decreasing scale, a compact high-power energy supply (e.g. 100 watts predicted at Tohoku University) has numerous applications. Micro-turbines can be used as a high-power portable energy source or as an air-vehicle propulsion method. Other Asian countries developing micro-flight systems include China and Korea.

The Tohoku University micro-turbine project fabrication philosophy differs from the micro-turbine research underway at the Massachusetts Institute of Technology (MIT) in the U.S. It is inline with Japanese precision-engineering fabrication techniques. The project will use a variety of fabrication methods including conventional lithography methods to scale the micro-turbine concept. The MIT approach follows the trend in the U.S. to produce primarily batch-fabricated devices based on Si lithography. The Tohoku University system will incorporate a SiC turbine 5 mm in diameter and .8 mm tall formed through a lost-mold sintering process. The planned fuel for the turbine is hydrogen. The dimensions enabled by the lost-mold process allow the fabricated turbine to match an optimized turbine design. Laser micromachining and traditional lithography fabrication methods will be used to form a bearing system to facilitate stable turbine rotation. Achieving stable turbine rotation has been a micro-turbine technical challenge. (Pokines)

Conference: The Thirteenth Annual International Conference on Micro Electro Mechanical Systems (MEMS2000), Miyazaki, Japan, January 23-27, 2000:
Ball Semiconductor Inc. (http://www.ballsemi.com) was established in 1996 by Akira Ishikawa, former vice president of Texas Instruments, to develop a semiconductor fabrication method that radically departs from traditional techniques. Ball Semiconductor is conducting an international development effort with research facilities in the U.S. and Japan. They presented the results of their 3 year product development effort. Aimed at applying their unique fabrication process to the development of integrated circuits, and microsystems, Ball's new fabrication approach is based on developing a 3-dimensional spherical lithography method and processing 1mm single crystal spheres (Figure 1) using non-contact material processes.

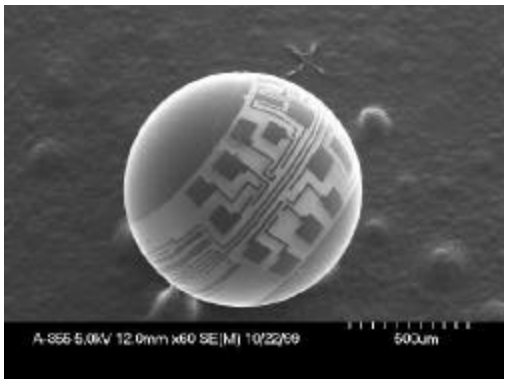


Figure 1. SEM image of 1-mm processed sphere
(courtesy Ball Semiconductor Inc.)

The potential payoff of this work is a three-fold increase in available fabrication space, 90% fabrication cost reduction vs. conventional flat chip technology, and reduced fabrication time. The company is focusing on developing 5 technologies: single-crystal sphere fabrication, non-contact process methods, spherical lithographic techniques, design protocols, and assembly methods. The company has shown the ability to process and stack spheres to develop clusters as shown. (Figure 2)

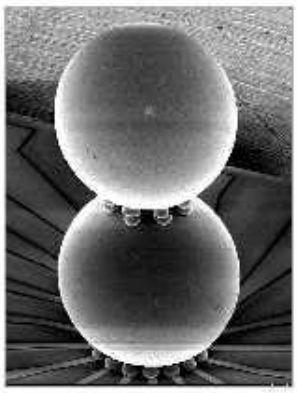


Figure 2. Image of sphere cluster
(courtesy Ball Semiconductor Inc.)

Joining Ball Semiconductor engineers at MEMS2000 were 515 researchers (a record number). The research presented highlighted efforts by Asian scientists. Japan, China, Korea, and Taiwan represented Asia with accepted abstracts. Japan is the leading Asian microsystem research country with Japanese researchers presenting 49 technical papers (highest country participation). This presence is a result of Japan's intensive microsystems development effort and the location of the conference. Japanese

academic institutions including Tohoku University, University of Tokyo, and Ritsumeikan University and Japanese industrial microsystem researchers had a significant presence at MEMS2000. The U.S.A. with 46 had the second highest number of accepted abstracts. Chinese researchers from Tsinghua University, Peking University, the Chinese University of Hong Kong, and the Chinese Academy of Sciences made a total of 8 presentations. Researchers from Korea made 7 presentations and Taiwan researchers made 3 presentations.

The large number of attendees, diverse range of topics, and refined devices presented demonstrated the maturity of microsystem technology. MEMS2000 was characterized by the realization, refinement, and expansion of previous technology visions and not by the presentation of revolutionary concepts. Some of these realized visions have resulted in the saving of billions of dollars for the auto-industry (i.e. pressure and acceleration sensors) and the creation of billion-dollar industries such as the inkjet printer market. (Pokines)

Conference: The 3rd France-Japan Workshop, From Nano to Macroscale Science and Technology Through Microsystems (N2M), Japan; 24-27 November 1999:
Since 1997 the N2M conference has been held annually to present and review research related to the Joint French-Japanese Microsystem Research at the University of Tokyo. In 1995, the University of Tokyo and The Centre National de la Recherche Scientifique (CNRS) formed a cooperative research relationship focused primarily on microsystem technology. The agreement provides an international bridge to exchange ideas and microsystem technology (MST) applications. In addition to the three founding French laboratories [Institute of Microtechniques of Franche Comté (IMFC) in Besançon, the Institute of Electronics and Microelectronics of Northern France (IEMN) in Lille, and the Laboratory for the Analysis and the Architecture of Systems (LAAS) in Toulouse] other French laboratories now participate. From the University of Tokyo, 8 professors from the Institute of Industrial Science (IIS) participate. This cooperative agreement resulted in the establishment of the Laboratory for Integrated Micro Mechatrainic Systems (LIMMS/CNRS-IIS). Research is performed at the University of Tokyo, allowing French researchers access to micro-fabrication hardware. A total of 12 CNRS permanent researchers (average stay in Japan of 3 years, maximum 6 years) and 17 JSPS funded French postdoctoral researchers (average stay 1-2 years) have participated in the joint research program. Currently 5 CNRS affiliated researchers and 7 JSPS postdoctoral researchers are located at the University of Tokyo.

Forty-six researchers from LIMMS and other Japanese and French research groups presented 31 research papers at the N2M conference. Biological, chemical, and mechanical system research related to micro-technology were among the topics of the conference. Many of the talks focused on applying micro-technology to the manipulation or analysis of nano-sized elements. Molecular surgery probes fabricated using Si based lithography methods were offered as examples of future MST medical devices. Another speaker outlined the goal of creating an integrated DNA manipulation and analysis system. A mechanical device was described that is designed to "swim" through human blood vessels. Like many of the presentations, the technology application was the treatment of medical disorders. Other topics related to future treatment tools included integrated chemical analysis systems on a chip, biochemical sensors, rapid molecular analysis systems, and laser manipulation of microbes. The biomedical applications of photonic crystals were also discussed. Presentations on near-field vibration spectroscopy and the effect of water absorption on the stiction of microstructures addressed the analysis and mechanics of microstructures. Methods to create metal tubular molecular networks and microstructures with proteins and bio-macromolecules were described. The advantage of these methods is the elimination of conventional lithography methods to form microstructures. (Pokines)

Electronics & Physics

Site Visit: Laser Machining at the Toyota Motor Corporation, Toyota City, Japan, 8 November 1999:
Toyota innovated the "just in time" manufacturing concept --making only what is needed, only when it is needed, and only in the amount that is needed. In October Toyota celebrated production of its 100 millionth domestic car! Production of vehicles consists of lots of piece work, a single vehicle consists of 30,000 parts (the engine alone has 550), and takes 20 hours of robot-assisted-human assembly. Steps include stamping, body welding, painting, assembly, adjustment and inspection. At Toyota, lasers are used in many of these steps, including the tailoring of panels (blanking, welding, and stamping) and the cladding of engine parts.

In use since 1985, laser welding of tailored blanks provides reduced panels with increased stiffness and decreased weight. For mating panels of dissimilar thicknesses, a 5-axis, 3 kW CO_2 laser robotic system with a ZnSe lens is used. It seams the dissimilar pieces with a

0.5 mm beam, 60-80 Hz zig-zag. YAG lasers with fiber-optic beam delivery systems are used for welding hems, cutting, and cladding. The YAG is used for cutting suspension members and headlamp holes in bumpers (first industrial use of lasers on plastics). YAG lasers are also used to weld the Al body parts (e.g., engine hood) and to clad the engine valve cylinder head and valve seats since conventional cladding methods result in a melting of the Al-base alloy metal. Toyota's laser cladding method improves heat transfer and resistance properties with minimal re-melt layer at the interface and fewer defects overall than CO_2 laser use. (Maurice)

Site Visit: Industrial Lasers and Machine Tooling at the Yamazaki Mazak Corporation, Nagoya, Japan, 9 November 1999:

The Japanese machine tool industry has progressed through several stages. First, there was the dominance of imported machine tools in the 1940's, then the introduction of new technologies from abroad in the 1950's and 60's, followed by the surge of domestic technology that continues to date. Today, under advancements in automation and numerical control, the Japanese machine tool industry is the largest in the world with Yamazaki Mazak at its lead. "Mazak" makes machines and it makes the machines that make machines. Its customers include the machine tool industry and the automotive, aerospace, shipbuilding, and oil drilling industries. By developing extremely efficient production systems, it has met customer demands. Mazak has systematically expanded the flexibility and intelligence of its machines by introducing advanced electronics and controls. Specifically, processes and control technologies have been integrated with peripheral equipment such as robots.

Producing highly reliable and precise machine tools since 1919, its headquarter plant (near Nagoya) started operation producing engine lathes. Now, besides being the corporate world headquarters and showroom, the plant produces the world's most sophisticated computer-numerical-control (CNC) multi-tasking turning centers, machining centers, and flexible, integrated, manufacturing systems. Most critical machine units (spindle assembly and headstock) are assembled in clean rooms under the strictest quality control conditions.

Mazak also leads in laser processing tools. The laser's performance and precision is superb -- much faster and more accurate than conventional multi-function turret punch presses. But Mazak combines both in machine tools (e.g., various CNC CO_2 laser processors) that are multi-process stations. In addition to cutting round and irregularly shaped holes, the laser tools cut holes for tapping and slits for louvers and lancing. This is coupled with yet another innovation from Mazak - the elimination of bottom surface marring. The table assembly moves with the workpiece throughout processing. Most remarkable about a visit to the plant is that the machines occupy such modest floor space. Japan is small; these machines comply with compactness and operate quietly. (Maurice)

Conference: The 9th International Conference on II-VI Compounds, Kyoto, Japan, 1-5 November 1999:

The II-VI '99 Compounds Conference convened in Kyoto, Japan with 320 participants. This conference was sponsored by the Japan Society for the promotion of Science, AOARD and several other organizations and provided broad coverage of both wide and narrow bandgap II-VI compounds. Topics included:

- Heterostructures (extensively)
- Charged excitons, microcavities, and low-dimensional systems
- Phospors and electroluminescence
- Diluted magnetic semiconductors
- Materials growth (bulk, epitaxial, impurity doping, conductivity control)
- Detectors & narrow bandgap semiconductors
- Light-emitting diodes (LEDs) & laser diodes (LDs)

The mixed crystals of II-VI compound semiconductor materials have attracted much optical device attention. The desire to produce short wavelength laser diodes motivates much of the research. Highlights include:

- Dr. Satoshi Itoh of Sony Corporation, in a plenary on the current status and future prospects of ZnSe-based LED devices, reported on Sony's longest lifetime green LD. The device operates continuously for 500 hrs at 20°C. Although Sony's ZnMgSSe-based LD is ready for optical disk systems, GaN has now taken the lead in this application because of its shorter emission wavelengths and well-established reliability. Thus ZnSe-based LDs will be developed for applications such as display and printing systems by utilizing their pure green emission at moderate speeds. Dr. Itoh believes that both material science and device physics of ZnSe-based LDs are still major concerns. Degradation by formation of a dense network of dislocations from these defects in the active zone underlies lifetime and reliability issues.

- To Dr. Masashi Kawasaki of the Tokyo Institute of Technology (Dept. of Innovative and Engineered Materials), ZnO is feasible as an optically functional semiconductor. ZnO has a direct band gap energy of 3.37 eV with a large exciton binding energy of 60 meV. Recently exciton emission and lasing from ZnO films have proven that ZnO is promising for

excitonic-based photonic devices in the UV wavelength regime. The exciton nature of these materials has potential for low-threshold LDs. Giving new life to an old material, Dr. Kawasaki's group developed alloy films and their heterostructures and superlattices, thus demonstrating the ability of bandgap engineering. His group overcomes the problems of p-type doping, long-time problematic in many semiconductor materials, in single-crystal thin films via nitrogen from a radical source.

- Also on this topic, Dr. Takafumi Yao's group at the Institute of Materials Research at Tohoku University, Japan, reported their research on the possibility of p-type doping and the origin of residual donors. With considerable expertise in ZnO compounds, the group has the ability to grow, by multiple techniques, both bulk ZnO and ZnO films on various kinds of substrates, including the epitaxial growth high-quality ZnO films on GaN epilayers. They report lattice matching MBE grown alloys to p-substrates with a wide range of lattice constants and energy gaps including ZnBeTe to GaAs and ZnSe (by p-doping the ZnBeTe and using p-GaAs), and ZnMgSeTe to p-ZnTe (reported for the first time). To assist in the problem of p-contacts for ZnSe-based lasers, they use plasma-assisted molecular-beam epitaxy (MBE) to grow the films. Their research indicates that a high temperature treatment of low-temperature ZnO layers holds promise for further growth of high quality ZnO layers. Dr. Yao further detailed the group's work on these topics as a recent WOS participant.
- Dr. Maria Tamargo of City College of New York reported on recently achieved optically-pumped red, green, and blue LEDs made from ZnCdMgSe, a wide-bandgap II-VI family of semiconductor alloys that can be grown lattice-matched to InP substrates. Such materials hold promise for integrated full-color display elements. (Maurice)

Conference: 6th Symposium on Interface '99 (50th Anniversary of Science Council of Japan), Tokyo, Japan, 10 December 1999:

The object of the symposium was to discussing systematically how the structure of hetero-interface is controlled and utilized for controlling electronic properties of devices. The symposium lectures were provided by representative scientists in each area:

- Progress of quantum hetero-structures and control of interface properties - quantum box and quantum wire, H. Sakaki (Tokyo University),
- Magnetic/nonmagnetic layer device and interface: MRAM and TMR, K. Inomata (Toshiba Corp.).
- Electrode technology for wide gap semiconductors and effects of interface, M. Murakami (Kyoto Univ.).
- Scaling of MOSFET and control of Si/SiO_2 interface, M. Hirose (Hiroshima Univ.).
- Progress of ferro-electric memory and high dielectric constant insulator film - FRAM, H. Ishihara (Tokyo Inst. Tech.).
- AlGaN/GaN/GaInN devices and effects of interface, I. Akasaki (Meijo Univ.).
- Development of organic photoelectric devices by interface control; optical-optical conversion and optical computing devices, M. Yokoyama (Osaka Univ.).
- For the next generation electronic-, magnetic- and photonic- devices, challenging issues and possible device properties were compared and explained.

Recent advanced solid state devices take advantage of solid interface well refinedly. Active layer thickness of advanced devices is generally set at less than 10nm, especially in key devices such as semiconductor laser diode and field effect transistors. This means researchers need a technology which makes manipulation of hetero-interface structure on an atomic scale possible. Semiconductor super lattice devices consist of nano-scale hetero-structures formed with ultra thin films (10 nm) and provide anomalous functions realized only through active use of quantum wave mechanical properties of electrons. The same properties are applied to magnetic electron devices (spin-electron devices). Moreover, quantum wire and quantum box of 10nm geometry have been proposed and developed for novel high speed and low power function devices. For further information, contact Prof. Sakaki of Tokyo University (e-mail: sakaki@iis.u-tokyo.ac.jp). (Miyazaki)

Conference: f^{t} Symposium on Ecologically Friendly Semiconductors, Saitama University, Japan, 21-22 December 1999:

The new term " Kankyo Handotai" in Japanese means ecologically friendly semiconductor materials. It is a novel paradigm of material science where only abundant and nontoxic chemical elements are used for the fabrication of current and future electronic devices such as energy regeneration and opto-electronic devices. Typically these semiconductor materials are composed of elements with a large Clarke number. They include not only elemental semiconductors such as Si and C, but also compound materials such as SiC, GaN, Cu_2O and beta-$FeSi_2$. Among these, beta-$FeSi_2$ is one of the most promising next generation compound semiconductors.

Approximately 150 researchers attended the 2 day conference, most from universities and institutes. Four plenary talks were provided;

- Introduction to Kankyo Semiconductor, Y. Maeda (Osaka Pref. Univ.).
- Applications to Thermo-electric Energy Conversion materials - The Research to $FeSi_2$ Thermoelements - I. A. Nishida (National Research Institute for Metals).
- Development of Shaped Crystal Technology by Liquid Casting Process, S. Sakuragi (Union Materials)
- Material Research and Collaboration among National Institutes, Universities and Private sectors, E. Maruyama (National Graduate Institute for policy Study, and RIKEN).

Then 33 papers were presented (mainly about thin film growth, crystal growth and device characteristics of beta-$FeSi_2$). New devices were proposed - fully silicon based opto-electronic-magnetic integrated devices, high energy payback solar cells and high efficiency thermoelectric elements. The four technological barriers to be overcome were described for realizing these proposed devices. For further information, contact Prof. K. Miyake (Graduate School of Saitama Univ., e-mail: kmiyake@d-kiki.ees.saitama-u.ac.jp) (Miyazaki)

Conference: The 9th US-Japan Seminar on Dielectric & Piezoelectric Ceramics, Okinawa, Japan; 2-5 November 1999:

Dielectric and piezoelectric materials are insulators with useful polarization characteristics and electromechanical properties with respect to external electric fields. They can be utilized in a broad range of devices such as capacitors, non-volatile memories, dynamic random access memories (DRAM), Electro-Optic modulators, transducers, and actuators. Fast-growing industrial applications include telecommunication, personal computing, and medical imaging.

Over 100 papers (1/3 from the US, 2/3 from Japan) were presented in this bi-annual US-Japan seminar. The seminar consisted of five sessions: Basic Science, Piezoelectric Materials and Devices, Thin Film Dielectrics, Multilayer Ceramic Capacitors (MLC), and Advanced Processing and Packaging. AFOSR/AOARD and HQ ONR co-sponsored the seminar.

Manufacturers gave the majority of presentations relating to MLC. This technology promises higher performance and further miniaturization of such devices as cellular phones and personal computers. MLC manufacturers are aiming to reduce layer thickness, increase capacitance per unit volume, and eliminate the use of the expensive Palladium electrodes. Dr. Sakabe of Murata Manufacturing Company reported the status of MLC technology in Japan. Murata has developed ultra-fine $BaTiO_3$ powder, and succeeded in producing nearly 1000 layers of defect-free ultra-thin films alternated by base-metal electrode layers. It is also developing an MOCVD method (replacing the sheet casting method) to further reduce the layer thickness to a sub-micron range. It has already demonstrated a 10-fold improvement in volumetric efficiency of capacitance. According to Prof. Randall of the Pennsylvania State University, Murata's achievement represents a break-through in MLC technology.

The focus of the Thin Film Dielectrics session was deposition techniques for applications in DRAM, non-volatile memory, and transistors. The film must be deposited at a low enough temperature to be compatible with the IC processing. However, in some low-temperature deposition techniques, a pyrochlore phase, which does not contribute to the figure of merit, tends to form instead of the useful perovskite crystal structure. More than half of the presentations discussed Lead-Zirconium Titanate (PZT) since its high remnant polarization has been known to be most suitable for memory applications. However, a considerable number of papers discussed Bismuth layered ferroelectrics because they are lead-free, and promise low voltage operation and resistance to fatigue (= loss of remnant polarization with cycling). Prof. Takenaka from Science University of Tokyo reported important data suggesting that this class of materials may retain memories up to 10^{11} cycles.

The DoD, especially the Navy, who has historically had an interest and expertise in transducers and acoustic filters, funded the majority of the US presenters in the Piezoelectric session. Large piezoelectricity useful for actuators and transducers are observed in lead-containing relaxer compounds, but considerable efforts have been devoted to development of lead-free perovskites. Prof. Harmer from Lehigh University and Dr. Yamada from Cerone, Inc. reported on a new single crystal growth technique that takes the advantage from the discontinuous (or exaggerated) grain growth phenomena. Using this revolutionary technique, a complex-shaped ceramic part may be recrystallized into a single crystal. There was no report from Japan in this seminar relating to this technique, although the technique was originally developed by NGK in Japan to convert a polycrystalline ferromagnet to a single crystal.

Overall, the trend toward miniaturization, cost reduction, and environmental concerns are driving new R&D needs for materials and processing technologies. (White)

Site Visit: Ewha Women's University, Optics Laboratory, Department of Physics, Seoul, Korea (Professor Jeong Weon Wu); 12 November 1999:

In 1886, Mrs. Mary F. Scranton, a Methodist missionary, founded Ewha Women's University as the first institution

in Korea to educate women. Accredited as a four-year university in 1946 by the new Korean government, today it is a top-rated academic university consisting of 14 colleges with 66 departments, 9 graduate schools, and 29 research institutes. It is the largest institution of its kind in the world, with 20,000 undergraduates and graduates and 650 faculty members. The 14 colleges include a law school, a medical school, a business school, and an engineering school, schools you don't find in most women's universities.

Prof. Jeong Weon Wu has established an optics laboratory equipped with world-class instruments. Among the 35 graduate students in the Physics Department, 12 of them are studying optics under Prof. Wu. Student's research highlights:

Laser Facilities: A doubled Nd YAG pumped Ti: Al_2O_3 laser is used to generate wavelengths from 740nm to 840nm. The goal is to extend the tunability to near infrared 1000nm. A doubler/tripler is utilized with the Ti: Al_2O_3 laser to produce ultraviolet 218 nm.

Infrared Wavelength Conversion: Their goal is to produce mid infrared 3.38-micron laser wavelength more efficiently using an Optical Parametric Oscillator (OPO) with 1.06 micron input. With 140mJ YAG laser input, the students have achieved 13 mJ output using a $LiNbO_3$ OPO crystal.

Femto second measurement: Optical-limiting behavior in phthalocyanine molecular systems was observed at femto second pulse regime. Chi-three values are determined using a Z-scan technique and by measuring a change in absorption as a function of intensity.

Electro-optic coefficient: A shearing Interferometry at 830nm is used to determine the Pockels coefficients in electro-optic polymers. The shearing interferometry benefits from the superb stability of interference fringes compared to other types of two-beam interferometry.

Optical characterization: A spectropolarimeter is used to determine n and k of NLO molecules-doped chitesan polymeric systems. Optical rotary dispersion and circular dichroism related to optical activity of chiral materials are studied. Total internal reflection is used to determine n and k of self-assembled system. The effect of molecular alignment on the NLO properties is investigated. The quantum confinement effects in Quantum Wires fabricated by the HeCd interferometric lithography is characterized.

Materials characterization labs for students include state-of-the-art instruments such as micro Raman, Triple Raman, as well as several NMR's. Financial support for the purchase of the equipment came from both the Korean government and industry. Overall, students in Prof. Wu's lab are given excellent opportunities to conduct research, and they have been very active in publishing their results. (White)

Window on Science: Dr. Masahito Watanabe, NEC Corporation, 5-15 December 1999:
As ultra-large-scale integrated circuits (ULSIs) achieve ever finer-scaled patterns and greater device densities, the quality of silicon wafers has become increasingly important. Larger-diameter (>300 mm) silicon crystals are required for ULSI. Conventional Czochralski (CZ) methods used to grow such crystals results in oxygen-atom contamination which adversely affects both production yield and ULSI reliability. Parameters contributing to this problem are heat and mass transfer in the melt during crystal growth. As a means of controlling them, a group led by Dr. Masahito Watanabe of the Fundamental Research Laboratories at NEC Corporation developed a unique technique of pulling the crystal from a melt as it is spontaneously rotated by an electromagnetic force. This new method called "electromagnetic Czochralski (EMCZ) method" simultaneously controls oxygen concentration while maintaining the homogeneity of its distribution. On a recent WOS, Dr. Watanabe detailed this effective new method to researchers at several locations including AFRL/SNHX, the New England Crystal Growth Society Meeting, Boston University (Prof. M. Gevelber), and SUNY Stonybrook (Prof. V. Prasad). He also described methods developed by his group at NEC to define thermophysical properties of molten silicon over wide-range temperatures including undercooled regions. These methods are based on X-ray diffraction and electromagnetic levitation. Due to atomic unknowns in molecular dynamics modeling, conventional computer simulation tools cannot provide the details. Further collaboration with SNHX on the EMCZ topic as pertains to issues in InP crystal growth is expected. POC: Dr. David Bliss, AFRL/SNHX. (Maurice)

Human Systems

Conference: The Fifth International Display Workshop (IDW '99), Sendai, Japan; 1-3 Dec. 1999:
Held annually in Japan since 1994, the 5th International Display Workshop featured 284 presentations from 17 countries. This annual conference represents the first such chapter conference elevated to international status for a chapter formed outside of North America. The display business continues to boom despite an economic turn-down.

There were over 100 papers on LCDs (2/3 from Japan). LCD sales are now approaching those of CRTs and considerable progress has been made in resolving problems such as viewing angle limitations and uniformity of contrast and color. There were 52 papers on Plasma Displays (25 from Korea), twice that of last year. Japan and Korea have invested billions of dollars in large area plasma displays. There were 21 papers on Field Emission Displays from Japan, Korea, Taiwan, France, the U.S., and China. The joint Human Factors / 3D Display Technologies sessions placed emphasis on visual and autonomic system interaction with 3D displays.

Upcoming display technology conferences include:

- The 1st International Display Manufacturing Conference & Exhibition, Seoul, Korea; 5-7 September 2000
- The 6th Asian Symposium on Information Displays & Exhibition, Xian Jiaotong University, Xian, China, 18-20 October 2000
- The 10th International Workshop on Inorganic and Organic Electroluminescence (EL '00), Hamamatsu, Japan; 4-7 December 2000

Contact AOARD for more information. (Lyons)

Conference: International Robot Exhibition 1999, Tokyo Big Sight, 26-29 October 1999:
Fanuc, Yasukawa, Nachi, and Kawasaki (4 "big" Japanese robot manufacturers), as well as numerous other manufacturers including Yamaha, Mitsubishi, Kokuho, Panasonic, etc. were represented with a huge range of robot related exhibits. The largest area was devoted to industrial applications such as welding, painting, materials handling, assembly, garbage collection, etc. New developments included open architecture controllers with a built-in PC system controller. 3D vision sensors were demonstrated in applications such as bin picking (Fanuc). Other interesting applications included Security robots, an unmanned helicopter prototype (Secom), and a prototype lunar rover. Medical applications such as tele-micro surgery, a therapeutic exercise machine and a robot for feeding paraplegics were also demonstrated. There were also demonstrations of humanoid robots as well as the continuing fascination with animal-like "pet" robots. (Lyons)

Site Visit: Open House, Advanced Telecommunications Research (ATR) Institute International; Kyoto, Japan, 4-5 November 1999:
The Open House showcased a wide variety of ATR research at ATR's four laboratories:

- Human Information Processing (HIP): Research on human communication including speech production, speech perception, 3-D visualization/virtual reality, hand tracking, computer learning, artificial intelligence, evolutionary neural networks, and computer evolution.
- Interpreting Telecommunications (ITL): Research on language translation, speech recognition, and speech synthesis.
- Media Integration and Communications (MIC): Research to facilitate communication between people at distant locations via virtual environments including multi-media communication, virtual reality, scene generation, image processing, facial expression, gestures and other non-verbal communication recognition, 3D displays, haptic displays, and development of intelligent interface agents.
- Adaptive Communications (ACR): Research on adaptive communications networks, design and control of complex adaptive systems, intelligent transmission and reception schemes, and advanced communication devices.

It should be noted that is spite of its' name, ATR research does not emphasize telecommunications hardware and three of the four ATR laboratories have significant programs related to man-machine-interface (HIP, ITL, and MIC). This impressive annual event is recommended for AFRL scientists interested in the above research areas. (Lyons)

Conference: Symposium on Energy Engineering in the 21st Century, Hong Kong University of Science and Technology, Hong Kong; 9-13 January 2000:
Hosted by the Centre for Energy and Thermal Systems & the Department of Mechanical Engineering, 226 papers were presented in 25 technical sessions attended by 260 scientists from 13 countries. Dr. Juan Vitali from the Air Force Research Laboratory gave a presentation on Trifluoro Methyl Iodide (CF3I) as a Halon 1301 Replacement for Fuel Tank Inertion Applications.

The Conference included a technical tour of the Centre for Energy and Thermal Systems with research programs in electronic cooling, air conditioning and refrigeration, fire and waste incineration, and drying & food processing. Facilities included a controlled environmental multi-test facility for energy efficiency grading, wind-wave channel, cryocooler testing rig, hot wire and 3D laser anemometer, high speed camera, and analytic equipment for gases, particulates, and volatile. Prof. Hassan B. Ali of the Office of Naval Research (ONR) International Field Office visited the Environmental Protection Department of Hong Kong and was quite impressed. Their web site http://www.info.gov.hk/epd/ includes some of their publications. (Lyons)

Site Visit: Civil Engineering Research Institute, Hokkaido Development Bureau, Sapporo, Japan, 8 October 1999:
This nationally funded institute conducts environmental engineering research as well as civil engineering research such as river hydraulics, harbor engineering, fisheries engineering, structures, geo-technical, traffic engineering, disaster prevention, soil conservation, agricultural engineering and geology. Environmental research includes the study of lake and river water quality, the effects of global climate change, dam and river management, and disaster control. The Institute also specializes in cold weather technologies including winter road safety, winter road management, pavement maintenance, and the effects of deicing salts on concrete. Special facilities for environmental research include a 50 meter channel for measuring oil dispersion, a high speed hydraulic tunnel, a $1/25^{th}$ scale inundation model, and a 30 meterx3 meter meandering channel. (Lyons)

Site Visit: Graduate School of Frontier Sciences, University of Tokyo, 24 January 2000:
This school was established in 1998 on the Hongo campus of the University of Tokyo. (Here "frontier" means "new" or "undiscovered".) It is scheduled to move to the University of Tokyo's third campus in Kashiwa, Chiba Prefecture, when completed. The keyword of this new school is "transdiscipline" since research spans different disciplines. The Hongo and Komaba campuses are to inherit the traditional disciplines and promote interdisciplinary educational research to explore new research fields in which different disciplines co-exist.

Six keywords best describe the research fields in the Graduate School of Frontier Sciences: materials, energy, information, complexity, bio-science, and environment. The School plans to break the current disciplines apart and reorganize them to create a completely new framework of research programs to meet the challenges of the above fields related to human social activities. The school is divided into three divisions. The largest, the Division of Interdisciplinary Sciences, is organized into four departments: Advanced Material Sciences, Advanced Energy, Frontier Informatics, and Complexity Science and Engineering. The Division of Integrated Bio-sciences has two research departments. One deals with "structure life science", in which research and education are used to explain fundamental principles supporting life phenomena. The other is "functional life science", in which complex life functions are analyzed at various stages from molecule- and cell- level to organ- and individual- level. The Division of Environmental Studies conducts educational research on policy planning and technical development work for the earth's environment by examining the human environment in terms of nature, culture, and society. The web page for the Graduate School of Frontier Sciences is http://www.k.u-tokyo.ac.jp/e/index.html. (Gaudreault)

Environmental Research in Review

Environmental Research in Japan:

At a recent environmental conference in Kyoto, one European scientist commented on the "seismic shift" in Japanese environmental awareness. The Dean of Engineering of Kyoto University in his Introductory remarks to the ECOHAZARD '99 Conference in Otsu, Japan on 6 December 1999, stated that along with information technology and biotechnology, environmental technology would be one of the three main emphasis areas for the next century. The Governor of Shiga attended the opening of the conference and the evening reception. In Shiga popular concern of the deterioration of water quality in Japan's largest lake has resulted in government action including the funding of a special institute - the Lake Biwa Research Institute. The Governor stressed that Japan has realized that it needs to balance industrialization with environmental concerns stating water will be more valuable than gold. Certainly increased the public concern with the environment is also seen in regular newspaper articles, for example, on endocrine disrupters and dioxin being produced by incinerators in the Tokyo area. A new Dioxin Law went into effect in 1999.

This increased awareness is also evident in government. Pollution control expenditures in Japan of 1.6% of GDP are comparable to those of then U.S. (1.6%) and government investment in environmental R&D was 0.6% of Japan's government R&D expenditures (vs. 0.7% for the U.S.)(Japan 2000 International Comparisons, Keizai Koho Center,1998 data, p-83). According to a 1999 Japan Statistics Bureau Survey, Japan's annual expenditure on environmental protection research increased by 5.3% in 1998. An additional 1,105 billion yen is spent on energy related R&D. In the past the government had emphasized research in areas where Japan had suffered environmental disasters: mercury, cadmium, ionizing radiation, etc. Recent government funded research areas have included endocrine disrupting chemicals and dioxin pollution. The status of environment in the national government will further improve when in January 2000 the Environmental Agency will be upgraded to Ministry status.

Environmental Research in Australia:

Although Pollution control expenditures in Australia of 0.9% of GDP were not as high as those in Japan and the U.S. (1.6%), government investment in environmental

R&D was funded well with 2.7% of Australia's government R&D expenditures (vs. 0.6% for Japan) (Japan 2000 International Comparisons, Keizai Koho Center, 1998 data, p-83).

Environmental Research in Korea:
Environmental technology is currently under-developed in Korea, but the government goal is to raise this level to that of advanced countries, to improve adherence to existing environmental standards, and to minimize trade friction with other countries caused by environmental issues. The government has formulated a G-7 Environmental Engineering Technology Development Project.

Associated Site Visits:

Conference: IAWQ, 3rd IAWQ Specialized Conference on Hazard Assessment and Control of Environmental Contaminants: ECOHAZARD '99, Otsu, Japan, 5-8 December 1999:
Hosted by the Research Center for Environmental Quality Control, Kyoto University, the Conference covered both toxicology and environmental issues. papers were presented in Technical sessions attended by 163 scientists from 16 countries. Areas emphasized included genotoxicity, endocrine disrupters, heavy metals, radionuclides, PCB and organochlorine contamination, ecological toxicity, physical and biological treatment of environmental contaminants, and risk assessment. The Conference included a Technical Tour of the Research Center for Environmental Quality (RCEQ) and the Lake Biwa Research Institute. (Lyons)

Site Visit: Research Center for Environmental Quality Control, Kyoto University; Japan, 24 June 1999:
With a staff of 5 full-time professors, 1 visiting professor and 20 graduate students, this Center conducts research in water pollution control in lakes and rivers, wastewater treatment, and toxic waste management at landfill sites. Recent work includes studies of natural fate and transport of pollutants, biodegradation, endocrine disrupters, and DNA strand breaks.

Site Visit: Lake Biwa Research Institute. Otsu, Japan; December 8, 1999:
With a budget of over $2 million and 14 researchers this institute has programs in research, scientific information and library service, and public relations. (Lyons)

Site Visit: The Commonwealth Science and Industrial Research Organization (CSIRO), Soil and Water Division, Adelaide Site and Perth Site, Australia, 27 and 29 September 1999:
The Commonwealth Science and Industrial Research Organization (CSIRO), with a staff of approximately 5,500 and a budget of $689 million (35% from external sources), is Australia's largest research organization. The CSIRO Soil and Water Division has a staff of 500 people. The scientific staff of the Division's Remediation Program includes 28 at the Adelaide site and 12 at the Perth site plus 9 Ph.D. students. The research ranges from laboratory research to innovative pilot studies. The CSIRO home page is at http://www.clw.csiro.au/research/

At the Adelaide site research includes the study of low level contaminant analysis (Dr. Ravi Naidu), study of soil characteristics, contaminant interaction and remediation (heavy metals, pesticides, and industrial organics such as PAH, PCB, and TCE)(Dr. Rai Kookana), and designer clays. At the Perth site research includes surface/groundwater interaction (Jeff Turner), assessment and in-situ remediation of groundwater and soils contaminated by organic compounds and wastes (Greg Davis).. Field studies have been conducted on various remediation technologies including bio-venting, bio-piling, and land farming. Interesting field studies are underway on technologies to enhance natural attenuation at the BP Refinery in Kwinana.

Site Visit: the Centre for Groundwater Studies; Perth, Australia; 29 Sep. 1999 (Director: Dr. Chris Barber):
Collocated with CSIRO is the Centre for Groundwater Studies conducts research, provides consultation, and offers specialized training courses. Research includes sustainability of groundwater resources, assessment and remediation of contaminated groundwater and soils, surface water-groundwater interaction, groundwater quality management and protection, water reclamation, salinity management, and geophysical characteristics of groundwater systems. http://www.clw.csiro.au/CGS

Upcoming conferences include:

- 2000 Contaminated Site Remediation Conference, Melbourne, Australia; 4-8 December 2000 (CSIRO/Greg Davis)
- Hydro2000, Perth, Australia; 20-23 November 2000 (CSIRO/Jeff Turner)
- Centre for Groundwater Studies Workshop in Thailand; July 2000(Chris Barber)

Contact AOARD for more information. (Lyons)

Site Visit: Institute for Environmental Research, Yonsei University, Seoul, Korea (Professor Yong Chung):
Founded in 1968, this was the first institute in Korea dedicated to environmental research. Research is conducted in toxicology, health risk assessment, environmental impact assessment, remediation

technology, water treatment technologies, environmental monitoring technology, and contaminant analysis.

National Institute of Environmental Research (NIER):
Founded in 1978, programs include environmental research and development, environmental education, supervising the G-7 Project and providing scientific data for the establishment of a national environmental policy.

Korea Institute of Science and Technology (KIST), Seoul, Korea:
Environmental Technology R&D includes:

- Development environmental engineering technology in the areas of water quality, waste, and pollution.
- Development of environmental ecology technology, environmental health, global environmental preservation technology and integrated environmental base technology.
- Support of medium and small startup firms.
- Development of low-emissions automobiles.

Site Visit: Chongyang Provincial College, Department of Environmental Management, Chungcheongnam, Korea:
Dr. Yang has developed the use of a hollow fiber membrane combined with anaerobic/toxic activated sludge process for the treatment of wastewater. Dr. Yang proposed this for treatment of airline facility wastewater and he was planning a field study of the process at a Korean Air force Base. The proposed advantages include the ability to treat wastewater high in chemical oxygen demand and N-Hexane without the need for a settling tank. Other research within the Department includes development of a two-phased anaerobic packed bed reactor to treat high organic wastewater as well as the design of pollution control devices for flue gas. (Lyons)

Upcoming Conferences In Asia

These upcoming conferences may be of interest to you. Contact us for more details or check our homepage at http://www.nmjc.org/aoard/ Conferences in **BoldFace** are AFOSR/AOARD Sponsored.

Date	Name	Place
Mar 15-17, 00	JFCC International Workshop on Fine Ceramics 2000	Nagoya, Japan
Mar 15-17, 00	The 3rd NIMC International Symposium on Photoreaction Control and Photofunctional Materials	Tsukuba, Japan
Mar 22-26, 00	Tokyo Aerospace 2000	Tokyo, Japan
Mar 23-24, 00	2000 Topical Symposium on Millimeter Waves	Yokosuka, Japan
Mar 27-30, 00	International Conference on Physiological and Cognitive Performance in Extreme Environments	Canberra, Australia
Mar 27-31, 00	**An Introduction to Using Anthropometry for Effective Solutions**	**Sarawak, Malaysia**
Mar 27-31, 00	**12th International Conference on Ternary & Multinary Compounds (ICTMC-12)**	**Taiwan**
Mar 27-31, 00	Conference on High Performance Scientific Computing (HPSC)	Hanoi, Vietnam
Apr 3-7, 00	International Power Electronics Conference (IPEC-Tokyo 2000)	Tokyo, Japan
Apr 12-13, 00	Photomask Japan 2000	Yokohama, Japan
Apr 24-25, 00	International Symposium on Low-Power and High-Speed Chips-Cool Chips III	Tokyo, Japan
May 7-12, 00	USARPAC Asia-Pacific Military Medicine Conference X (APMMC X)	Singapore
May 14-17, 00	The Fourth International Conference/Exhibition on High Performance Computing in Asia-Pacific Region (HPC-Asia 2000)	Beijing, China
May 21-26, 00	2000 IEEE 6th International Conference of Properties & Applications of Dielectric Materials	Xi'an, China
May 22-25, 00	Fourth International Commission on Non-ionizing Radiation Protection Workshop	Kyoto, Japan
May 23-26, 00	Advanced Underwater Technologies for the 21st Century	Tokyo, Japan
May 30-Jun 15, 00	International Conference on Role of Mesomechanics for Development of S&T Mini-Symposia on Use of Intelligent Material Computational Mechanics Composite Technologies	Xi'an, Beijing, Dalian, Shanghai, China

May 31-Jun 2, 00	SEMICON Kansia 2000	Osaka, Japan
Jun 5-9, 00	The 10th International Conference on Metal Organic Vapor Phase Epitaxy	Hokkaido, Japan
Jun 14-16, 00	**The First International Symposium on Laser Precision Microfabrication (LPM2000)**	**Saitama, Japan**
Jun 26-29, 00	Australian Conference on Optical Fibre Technology (ACOFT). Workshop on Broadband Networks. Workshop on Nonlinear Waveguiding	Canberra, Australia
Jun 29-30, 00	International Workshop on Femtosecond Technology (FST 2000)	Tsukuba, Japan
Jul 2-6 00	**9th US-Japan Conference on Composite Materials**	**Shizuoka, Japan**
Jul 9-13, 00	2000 International Symposium on Environmental Biotechnology	Kyoto, Japan
Jul 9-14, 00	**22nd International Symposium on Rarefied Gas Dynamics (RGD22)**	**Sydney, Australia**
Jul 11-13, 00	2000 International Microprocesses & Nanotechnology Conference	Tokyo, Japan
Jul 11-14, 00	Fifth Optoelectronics and Communications Conference	Chiba, Japan
Jul 12-14, 00	The International Workshop on Activematrix Liquid-Crystal Displays-TFT Technologies & Related Materials	Tokyo, Japan
Jul 24-28, 00	International Liquid Crystal Conference (ILCC 2000)	Sendai, Japan
Jul 26-28, 00	**Photonic Taiwan 2000**	**Taipei, Taiwan**
Aug 6-11, 00	**7th International Symposium on Polymer Electrolytes (ISPE7)**	**Queensland, Australia**
Aug 14-18, 00	International Symposium on Applied Mathematics	Dalian, China
Aug 16-18, 00	**4th International Conference on Fracture and Strength of Solids**	**Pohang, Korea**
Aug 18-20, 00	**2nd Asian-Australian Conference on Composite Materials (ACCM-2000)**	**Kyongju, Korea**
Aug 20-23, 00	**Topical Workshop in Heterostructure Materials (TWHM'00)**	**Japan**
Aug 22-24, 00	**3rd Composite Durability Workshop (CDW 2000)**	**Kanazawa, Japan**
Aug 27-Sep 1, 00	26th International Congress on Occupational Health	Singapore
Aug 28-31, 00	2000 International Conference on Solid State Devices and Materials (SSDM 2000)	Sendai, Japan
Aug 29-Sep 1, 00	The 1st Asian Conference on Crystal Growth and Crystal Technology	Sendai, Japan
Sep 5-7, 00	The 1st international Display Manufacturing Conference & Exhibition	Seoul, Korea
Sep 5-8, 00	International Symposium on Optical Memory 2000 (ISOM 2000)	Hokkaido, Japan
Sep 10-15, 00	The 11th International Conference on Molecular Beam Epitaxy	Beijing, China
Sep 11-14, 00	The 15th International Acoustic Emission Symposium 2000	Tokyo, Japan
Sep 13-15, 00	The International Conference on the Physics and Application of Spin-Related Phenomena in Semiconductors	Sendai, Japan
Sep 17-22, 00	25th International Conference on the Physics of Semiconductors (ICPS25)	Osaka, Japan
Sep 24-27, 00	The 9th International Conference on Shallow-Level Centers in Semiconductors	Hyogo, Japan
Sep 24-27, 00	**International Workshop on Nitride Semiconductors**	**Nagoya, Japan**
Sep 24-28, 00	The 9th International Conference on High Pressure Semiconductor Physics	Hokkaido, Japan
Sep 25-29, 00	The 14th Int'l Conference on High Magnetic Fields in Semiconductor Physics	Shimane, Japan
Sep 27-29, 00	9th International Symposium on Semiconductor Manufacturing (ISSM2000)	Tokyo, Japan
Sep 27-29, 00	IEEE International Workshop on Robot and Human Interaction (ROMAN2000)	Osaka, Japan
Oct 1-4, 00	6th International Conference on Soft Computing (IIZUKA 2000)	Fukuoka, Japan
Oct 2-6, 00	**Solar-Terrestrial Energy Program-Results, Applications and Modeling Phase**	**Sapporo, Japan**
Oct 18-20, 00	The 6th Asian Symposium on Information Displays & Exhibition	Xian, China
Oct 22-28, 00	IEEE International Conference on Industrial Electronics, Control and Instrumentation (IECON-2000)	Nagoya, Japan
Oct 25-27, 00	The Third Asia-Pacific Conference on Simulated Evolution and Learning	Nagoya, Japan
Oct 30-Nov 2, 00	Magneto-Optical Recording International Symposium and Asia-Pacific Data Storage Conference 2000	Nagoya, Japan
Oct 3-Nov 5, 00	International Conference on Intelligent Robots and Systems (IROS2000)	Kagawa, Japan
Nov 9-11, 00	Techno Ocean 2000	Kobe, Japan
Nov 13-17, 00	8th Conference on Frontiers of Electron Microscopy in Materials Science	Matsue, Japan
Nov 14-18, 00	**7th Int'l Conference on Neural Information Processing (ICONIP 2000)**	**Taejon, Korea**
Nov 15-17, 00	2nd International Conference on Optical Design and Fabrication (ODF2000)	Tokyo, Japan
Nov 19-23, 00	**International Conference on Communication Systems (ICCS'00)**	**Singapore**
Nov 20-23, 00	3rd International Hydrology and Water Resources Symposium (Hydro2000)	Perth, Australia
Nov 28-30, 00	IAPR Workshop on Machine Vision Applications (MVA2000)	Tokyo, Japan

Nov 28-Dec 1, 00	**4th Asia Pacific Conference on Computer Human Interaction (APCHI)** **6th S.E. Asian Ergonomics Society Conference (ASEAN Ergonomics)**	**Singapore**
Nov 29-Dec 1, 00	2nd International Conference on Experimental Mechanics	Singapore
Nov 29-Dec 1, 00	**International Display Workshop**	**Kobe, Japan**
Nov 30-Dec 2, 00	International Symposium on Electronic Materials and Packaging 2000 (EMAP2000)	Hong Kong
Dec 3-6, 00	Sustainable Energy and Environmental Technologies	Hong Kong
Dec 4-7, 00	The 10th International Workshop on Inorganic and Organic Electroluminescence	Hamamatsu, Japan
Dec 4-8, 00	2000 Contaminated Site Remediation Conference	Melbourne, Australia
Dec 5-7, 00	The 4th International Conference on Nano-Molecular Electronics (ICNME2000)	Kobe, Japan
Dec 11-15, 00	Australian Optical Society Conference Australian Institute of Physics Symposium	Adelaide, Australia
Feb 5-9, 01	**Semiconductor Nanostructures**	**New Zealand**
May 6-9, 01	**International Light Materials Conference (LiMat 2001)**	**Pusan, Korea**
May 14-18, 01	**Indium Phosphide and Related Materials, 2001 (IPRM'01)**	**Nara, Japan**
Jul 1-5, 01	Integrated Optics & Optical Communications Conference (IOOC) Opto-Electronics Communications Conference (OECC) Australian Conference on Optical Fibre Technology (ACOFT)	Darling Harbour Convention Centre, Sydney, Australia
Jul 1-6, 01	**5th International Symposium on Advances in Polymer & Composites-2001**	**Singapore**
Jul 24-27, 01	**2001 International Symposium on Signals, Systems, and Electronics**	**Tokyo, Japan**
Jul 29-Aug3, 01	The 18th International Conference on Crystal Growth (ICCG-13)	Kyoto, Japan
Oct 21-26, 01	8th International Conference on Environmental Mutagens	Shizuoka, Japan
Nov 11-16, 01	9th International Conference on the Conservation and Management of Lakes	Shiga, Japan
Jul 7-11, 03	5th International Congress on Industrial and Applied Mathematics	Sydney, Australia

Upcoming Window-on-Science Visitors

Contact us for more details if you are interested in the following WOS visitors.

Dates	Visitor Name	Affiliation and Country	Topic	Visit Location
16-18 Mar 00	Prof. Soon-Hyun Hong	Korea Institute of Advanced S&T (KAIST), Korea	Development and microstructural control of mechanically alloyed tungsten heavy alloys for penetrator applications	AFRL/ MNMW
16-18 Mar 00	Prof. Sung-Hak Lee	Pohang Univ. of S&T, Korea	The process of tungsten heavy alloys that promote cleavage fractures while having self-sharpening properties	AFRL/MNMW
29-31 Mar 00	Mr. Motoi Oishi	Japan Advanced Institute of Science and Technology, Japan	Synthesis of Stereoregular and Optically Active Poly(siloxane)s containing 1,3-dimwthyl-diphenyldisiloxane.	AFRL/MLBP
29-31 Mar 00	Mr. Rezaul Sheikh	Japan Advanced Institute of Science and Technology, Japan	Conversion of Oxyanion into Carbanion by using Silacyclobutanes (SB)	AFRL/MLBP
29-31 Mar 00	Prof. Yusuke Kawakami	Japan Advanced Institute of S&T, Japan	Synthesis and characterization of new organosilicon polymers	AFRL/MLBP
2-7 Apr 00	Dr. Toshiaki Asahi	Japan Energy Corporation, Japan	Crystal Growth of Semiconductor Compounds	AFRL/SNHX
19-21 Apr 00	Dr. Liyong Tong	University of Sydney, Australia	3D Woven Composites Adhesive Bonded Joints Composites	AFRL/MLBC
23 Apr-3 May 00	Dr. Shigeaki Uchida	Osaka University, Japan	Laser Removal of Space Debris and Laser Lightening Protection System	CHTM, UNM
24-28 Apr 00	Dr. Yuriko Aoki	Hiroshima University, Japan	Multiscale Modeling of Organic Materials	AFRL/MLBP

24-28 Apr 00	Dr. Koji Tashiro	Osaka University, Japan	Multiscale Modeling of Organic Materials	AFRL/MLBP
24-28 Apr 00	Prof. Masao Doi	Nagoya University, Japan	Modelling and Simulation Nanotechnology Organic Materials	AFRL/MLPJ
24-28 Apr 00	Prof. Yuji Sasanuma	Chiba University, Japan	Modelling and Simulation Nanotechnology Organic Materials	AFRL/MLPJ
2-4 May 00	Prof. Eric Miles Kennedy	The University of Newcastle, Australia	A Process for Conversion of Halon 1211	AFRL/MLQC
2-4 May 00	Prof. Bogdan Z. Dlugogorski	The University of Newcastle, Australia	Flammability Properties of Mixtures of Hydrocarbon Blends with CF31 and C3HF7	AFRL/MLQC
23 May 00	Prof. Hiroshi Hatta	Institute of Space and Astro Sciences, Japan	High Temp Oxidation Behavior of SiC-coated carbon/carbon composite.	AFRL/MLBC
4-7 Jun 00	Dr. Leon Phillips	Univ. of Canterbury, New Zealand	Astronomy, Chemistry, Physics	AFRL/VSBM
9-10 Jun 00	Prof. Kigook Song	Kyung Hee Univ., Korea	Reversible phochromic behaviors of azobenzene chromosphore in thin film.	AFRL/MLBP
10-14 Jun 00	Prof. John W. O'Byrne	University of Sydney, Australia	Optical Interferometry	AFRL/DEBS
15-17 Jun 00	Prof. Bumman Kim	Pohang University of S&T, Korea	Electronic Devices Millimeterwave Technology MMICs	AFRL/SNDI
15-17 Jun 00	Prof. Bongkoo Kang	Pohang University of S&T, Korea	Electronic Devices Millimeterwave Technology MMICs	AFRL/SNDI
26-27 Jun 00	Prof. Martin E.G. Helander	Nanyang Technology University, Singapore	Anthropometric Design of Workstations and Axiomatic Design	AFRL/HE
1-31 Jul 00	Dr. Ikai Lo	National Sun Yat-sen University, Taiwan	GaN Crystal Growth Techniques	AFRL/MLPO
16-18 Aug 00	Prof. Wan Soo Huh	Soonsil University, Korea	Physical Properties of Polyolefin Blends	AFRL/MLBP
20-23 Aug 00	Prof. Greg Walker	Univ. of Tasmania, Australia	Boundary Layer Transition and Unsteady Aspects of Turbonachinery Flows	Conference at Syracuse Univ, NY

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